PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 27 July 2000 (27.07.00)	
International application No. PCT/GB99/03785	**Applicant's or agent's file reference** MPS/7002INT
International filing date (day/month/year) 12 November 1999 (12.11.99)	**Priority date** (day/month/year) 14 November 1998 (14.11.98)
Applicant COLEY, David	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

18 May 2000 (18.05.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Zakaria EL KHODARY
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
SKINNER, Michael, Paul
Swindell & Pearson
48 Friar Gate
Derby DE1 1GY
ROYAUME-UNI

Date of mailing (day/month/year)	
25 May 2000 (25.05.00)	
Applicant's or agent's file reference MPS/7002INT	**IMPORTANT NOTICE**
International application No. PCT/GB99/03785	**International filing date** (day/month/year) 12 November 1999 (12.11.99)
Priority date (day/month/year) 14 November 1998 (14.11.98)	
Applicant ALDRIDGE PILING EQUIPMENT (HIRE) COMPANY LIMITED et al	

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,JP,KP,KR,MA,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AE,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CR,CU,CZ,DE,DK,DM,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,ZA,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   25 May 2000 (25.05.00) under No. WO 00/29678

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a **demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

more quickly and is therefore preferable for use near populated areas, particularly brown field sites. Other soil types are better served by impact driving, but this can cause problems from noise and shock waves. Legislation, particularly concerning health and safety, is becoming increasingly strict in respect of vibration and noise created by piling operations, and this presents a further factor influencing the choice of technique.

It is therefore conventional to build apparatus in a variety of different sizes and operating in a variety of different ways, so that an appropriate apparatus can be chosen for a particular situation. Unfortunately, problems with delay can then occur if it is found that the choice was inappropriate. Alternatively, equipment may be provided unnecessarily, so that alternatives are available on-site if required, but remain unused if not.

The present invention seeks to obviate or mitigate these or other disadvantages of the prior art.

The invention provides actuator apparatus comprising piston means operable to create driving forces from a supply of pressurised fluid, and valve means operable to supply pressurised fluid to the piston means according to a predetermined sequence, to cause the apparatus to execute a first operation, the valve means and the piston means being housed within a common member, and the valve means or the piston means or both being removable from the common member for replacement by an alternative means operable within the common member to cause the apparatus to execute an alternative operation.

We have realised that an actuator according to the invention can be used to apply vibration, impact or static forces to pile elements and also to tooling such as a compaction plate, an auger or mandrel, or demolition shears or cutters. Preferably the valve means is removable for replacement with an alternative valve means operable to supply fluid according to an alternative sequence. The valve means may comprise a spindle movable within a housing, there being hydraulic ports in the housing walls, and the spindle carrying

partitions which serve to change the connections between the hydraulic ports in accordance with the spindle position. The spindle is preferably rotatable to provide port connections in accordance with the predetermined sequence. The spindle may be axially movable to change the predetermined sequence. The spindle may have a first axial position at which a wider fluid path is provided to one face of the piston means than to the other, and be movable to a second axial position at which a narrower fluid path is provided to the said one face than to the other. The valve means may have a port having a width which is not constant in the axial direction of the spindle, whereby the effective width of the fluid path to the piston means can be set by setting the axial position of the spindle. The spindle may provide drive alternatively to opposite faces of a piston of the piston means, whereby to create reciprocation.

The spindle may be formed to complete a plurality of cycles of the piston means for each full turn of the spindle. The spindle may have a first axial position in which a first number of cycles are completed for each full turn of the spindle and a second axial position in which a different number of cycles is completed for each full term. The fluid path to the piston means may be relatively narrow in the first axial position, and relatively wide in the second axial position.

The valve means may comprise at least one member which is movable to alternative positions to cause the predetermined sequence to change in accordance with its position. Preferably, the said member is movable as aforesaid while the apparatus is operating.

The apparatus may further comprise intermediate means to which driving forces are provided by the piston means, and which convey driving forces to an item being driven. The item may be an item of tooling or a pile element. The intermediate member may provide for movement to align the tooling and may be operable hydraulically or pneumatically. The intermediate member may convey forces to clamping members by which a workpiece may

Fig. 14 shows the actuator 10 in use with an auger 132 to which the actuator 10 applies vibratory or impact forces to improve the effectiveness of the auger. An arrangement (now shown) may be provided to allow the auger 132 to be turned while being driven by the actuator 10.

It will be apparent that many variations and modifications can be made to the apparatus as described above without departing from the scope of the present invention. In particular, many features can be used interchangeably in combinations other than those described, which is a particular benefit of the invention. The block member could be assembled from more than one part. Many other piston operation sequences could be devised by appropriate modification of valve arrangements, so that operation of a machine can be modified at will by the simple expedient of appropriate modification to the valve assembly, thus retaining the machine flexible in its application.

Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

CLAIMS

1. Actuator apparatus comprising piston means operable to create driving forces from a supply of pressurised fluid, and valve means operable to supply pressurised fluid to the piston means according to a predetermined sequence, to cause the apparatus to execute a first operation, the valve means and the piston means being housed within a common member, and the valve means or the piston means or both being removable from the member for replacement by an alternative means operable within the common member to cause the apparatus to execute an alternative operation.

2. Apparatus according to claim 1, wherein the valve means is removable for replacement with an alternative valve means operable to supply fluid according to an alternative sequence.

3. Apparatus according to claim 1 or 2, wherein the valve means comprise a spindle movable within a housing, there being hydraulic ports in the housing walls, and the spindle carrying partitions which serve to change the connections between the hydraulic ports in accordance with the spindle position.

4. Apparatus according to claim 3, wherein the spindle is rotatable to provide port connections in accordance with the predetermined sequence.

5. Apparatus according to claim 3 or 4, wherein the spindle is axially movable to change the predetermined sequence.

6. Apparatus according to claim 5, wherein the spindle has a first axial position at which a wider fluid path is provided to one face of the piston means than to the other, and is movable to a second axial position at which a narrower fluid path is provided to the said one face than to the other.

7. Apparatus according to claim 5 or 6, wherein the valve means has a port

having a width which is not constant in the axial direction of the spindle, whereby the effective width of the fluid path to the piston means can be set by setting the axial position of the spindle.

8. Apparatus according to any of claims 3 to 7, wherein the spindle provides drive alternatively to opposite faces of a piston of the piston means, whereby to create reciprocation.

9. Apparatus according to any of claims 3 to 8, wherein the spindle is formed to complete a plurality of cycles of the piston means for each full turn of the spindle.

10. Apparatus according to claim 9, wherein the spindle has a first axial position in which a first number of cycles are completed for each full turn of the spindle and a second axial position in which a different number of cycles is completed for each full term.

11. Apparatus according to claim 10, wherein the fluid path to the piston means is relatively narrow in the first axial position, and relatively wide in the second axial position.

12. Apparatus according to any preceding claim, wherein the valve means comprise at least one member which is movable to alternative positions to cause the predetermined sequence to change in accordance with its position.

13. Apparatus according to any preceding claim, further comprising intermediate means to which driving forces are provided by the piston means, and which convey driving forces to an item being driven.

14. Apparatus according to claim 13, where the item is an item of tooling or a pile element.

15. Apparatus according to claim 13 or 14, where the intermediate member

provides for movement to align the tooling.

16. Apparatus according to claim 15, where the alignment movement is proviced hydraulically or pneumatically.

17. Apparatus according to any of claims 13 to 16, in which the intermediate member conveys forces to clamping members by which a workpiece is clamped, in use.

18. Apparatus according to any of claims 13 to 17, wherein the clamping members extend at an angle to the intermediate means to allow side or end clamping of a workpiece.

19. Apparatus according to any of claims 13 to 18, wherein the intermediate means is elongate.

20. Apparatus according to claim 19, wherein the intermediate means extends to one side of the common member.

21 Apparatus according to claim 18, 19or 20, wherein the clamping members extend substantially perpendicular to the intermediate means.

22. Apparatus according to any of claims 13 to 21, wherein the intermediate means extend through a passage within the piston means, and have enlarged heads against which the piston means may act in either of two opposite directions.

23. Apparatus according to any preceding claim, comprising resilient members against which the piston menas acts, in use.

24. Apparatus according to claim 23, wherein the piston means are isolated by the resilient members from direct impacts, whereby to create vibratory driving forces.

25. Apparatus according to claims 23 or 24, wherein the piston means create impact forces when the resilient members are fully compressed.

26. Apparatus according to any preceding claim, wherein the apparatus is adapted for resilient attachment to a mounting arrangement by means of which the apparatus may be supported by a conventional support arrangement.

27. Apparatus according to claim 26, wherein the support arrangement is provided by a conventional excavator or like machine.

28. Apparatus according to claim 27, wherein the support machine is operable to apply crowd forces to the apparatus.

29. Apparatus according to claim 27 or 28, wherein the support machine is able to supply pressurised fluid to the apparatus.

30. Actuator apparatus substantially as described above, with reference to the accompanying drawings.

31. Any novel subject matter or combination including novel subject matter disclosed herein, whether or not within the scope of or relating to the same invention as any of the preceding claims.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : E02D 11/00, 7/20, F15B 15/20, 15/18, 21/12 — A1

(11) International Publication Number: WO 00/29678

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(71) Applicant *(for all designated States except US)*: ALDRIDGE PILING EQUIPMENT (HIRE) COMPANY LIMITED [GB/GB]; Conduit Road, Conduit Industrial Estate, Norton Canes, Cannock, Staffordshire WS11 3TJ (GB).

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(75) Inventor/Applicant *(for US only)*: COLEY, David [GB/GB]; 119 Mill Road, Pelsall, Walsall, West Midlands WS4 1BU (GB).

(74) Agent: SKINNER, Michael, Paul; Swindell & Pearson, 48 Friar Gate, Derby DE1 1GY (GB).

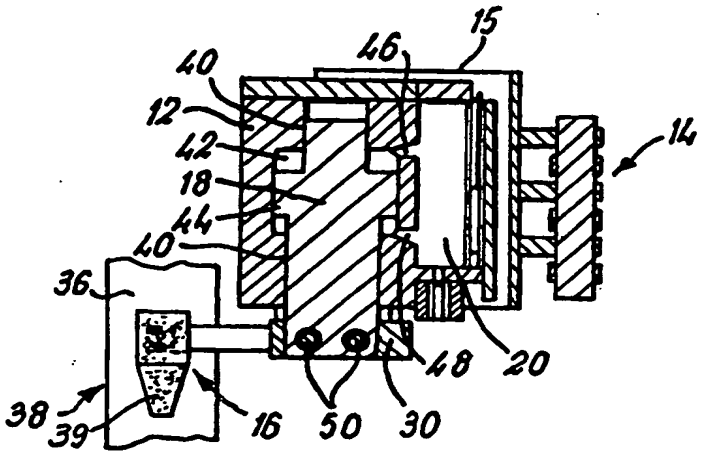
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: ACTUATOR APPARATUS

(57) Abstract

An actuator (10) for use in installing or extracting piles and the like has a common member (12) supported at (14) and having jaws (16) for gripping a pile. Within the block (12) a double-acting piston (18) is located alongside a space (20) for a control valve arrangement which provides hydraulic fluid, in various ways described, to create vibratory or impact forces from the piston (18). The piston and the valve arrangements are both removable and replaceable by alternatives, to modify the mode of operation of the actuator (10).



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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
MPS/7002INT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB99/03785	12/11/1999	14/11/1998
International Patent Classification (IPC) or national classification and IPC E02D11/00		
Applicant ALDRIDGE PILING EQUIPMENT (HIRE) COMPANY...et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 7 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
18/05/2000	02.03.2001
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer Kergueno, J Telephone No. +31 70 340 2369

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03785

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

1,4-14	as originally filed			
2,3,15	as received on	02/12/2000	with letter of	30/11/2000

Claims, No.:

1-26	as received on	02/12/2000	with letter of	30/11/2000

Drawings, sheets:

1/12-12/12	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application.

   ☒ claims Nos. 26.

because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

   ☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 26 are so unclear that no meaningful opinion could be formed (*specify*):
   see separate sheet

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination report cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the standard.

   ☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-25
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-25
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-25
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

Claim 26 relies on reference to the description and drawings and is therefore rendered unclear in scope, contrary to Article 6, cf. further PCT/GL/III 4.10.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Document US-A-4371042 discloses with reference to Fig.1 an actuator apparatus comprising piston means (2) operable to create driving forces from a supply of pressurised fluid, and valve means (6) operable to supply pressurised fluid to the piston means according to a predetermined sequence, to cause the apparatus to execute an operation, the valve means and the piston means being housed within a common member (1).

The subject-matter of claim 1 differs from what is known from said document (the said operation being termed as a first operation) in that the valve means or the piston means or both are removable from the member for replacement by an alternative means operable within the common member to cause the apparatus to execute an alternative operation, and through the features of the or each valve means as further recited in the characterising portion of said claim. Therefore claim 1 and thus claims 2-25 appended thereon fulfill the criteria set forth in Article 33(2).

2. The problem underlying the present invention may be formulated as to provide an actuator apparatus of the type set forth the operational mode of which can be readily adated to various factors encountered.

This object of versatility is achieved by replacement of the valve means, the piston means, or both by an alternative valve, respectively piston means to cause the apparatus to execute an alternative operation to the first operation, said versatility being enhanced by the features of the or each valve means which allow for a same valve means for changing the predetermined sequence.

The arrangement according to the above cited US-A-4371042 aims at facilitating removal of the valve means for maintenance or exchange purposes, though with no specific disclosure to such exchange being linked to the object of providing an alternative operation of the actuator.

The object of providing an alternative operation of a valve means for a same actuator is addressed in document EP-A-0388498 (cf. col.3/l.7-11) and solved (cf.col3/l29-42) by a readily exchangeable valve means adapted to the alternative operation.

It is further known from document DE-A-1957469 to modify the sequence of a piston means by providing a rotatable arrangement of a control valve for said piston.

None of the available prior art nor a combination thereof would however suggest to the skilled person the combination of features as recited in the characterising portion of claim 1, thus achieving the intended object of an enhanced versatility of the actuator apparatus. Claim 1, and therefore dependent claims 2-25, thus also fulfill the criteria set forth in Article 33(3), their subject-matter involving an inventive step.

Re Item VII
Certain defects in the international application

1. Document EP-A-0388498 cited in Item V, paragraph 2, is considered to represent the closest state of the art in view of the similarities of the problems addressed. (2p form not appropriate ...)

Re Item VIII
Certain observations on the international application

Clarity of alternative means in cl.1 (replace by alternative valve, respectively piston means)

"term" in claim 7 sholdhave read "turn".

more quickly and is therefore preferable for use near populated areas, particularly brown field sites. Other soil types are better served by impact driving, but this can cause problems from noise and shock waves. Legislation, particularly concerning health and safety, is becoming increasingly strict in respect of vibration and noise created by piling operations, and this presents a further factor influencing the choice of technique.

It is therefore conventional to build apparatus in a variety of different sizes and operating in a variety of different ways, so that an appropriate apparatus can be chosen for a particular situation. Unfortunately, problems with delay can then occur if it is found that the choice was inappropriate. Alternatively, equipment may be provided unnecessarily, so that alternatives are available on-site if required, but remain unused if not.

The present invention seeks to obviate or mitigate these or other disadvantages of the prior art.

The invention provides actuator apparatus comprising piston means operable to create driving forces from a supply of pressurised fluid, and valve means operable to supply pressurised fluid to the piston means according to a predetermined sequence, to cause the apparatus to execute a first operation, the valve means and the piston means being housed within a common member, and the apparatus being characterised in that the valve means or the piston means or both being removable from the member for replacement by an alternative means operable within the common member to cause the apparatus to execute an alternative operation, and wherein the or each valve means comprise a valve arrangement rotatable within a housing, there being ports in the housing walls for pressurised fluid, and the valve arrangement carrying partitions which serve to change the connections between the fluid ports in accordance with the predetermined sequence as the valve arrangement rotates, and wherein the valve arrangement of the or at least one of the valve means is axially movable to change the predetermined sequence.

We have realised that an actuator according to the invention can be used to apply vibration, impact or static forces to pile elements and also to tooling such as a compaction plate, an auger or mandrel, or demolition shears or cutters. Preferably the valve means is removable for replacement with an alternative valve means operable to supply fluid according to an alternative sequence. The valve arrangement may have a first axial position at which a wider fluid path is provided to one face of the piston means than to the other, and be movable to a second axial position at which a narrower fluid path is provided to the said one face than to the other. The valve means may have a port having a width which is not constant in the axial direction of the valve arrangement, whereby the effective width of the fluid path to the piston means can be set by setting the axial position of the valve arrangement. The valve arrangement may provide drive alternatively to opposite faces of a piston of the piston means, whereby to create reciprocation.

The valve arrangement may be formed to complete a plurality of cycles of the piston means for each full turn of the valve arrangement. The valve arrangement may have a first axial position in which a first number of cycles are completed for each full turn of the valve arrangement and a second axial position in which a different number of cycles is completed for each full term. The fluid path to the piston means may be relatively narrow in the first axial position, and relatively wide in the second axial position.

The apparatus may further comprise intermediate means to which driving forces are provided by the piston means, and which convey driving forces to an item being driven. The item may be an item of tooling or a pile element. The intermediate member may provide for movement to align the tooling and may be operable hydraulically or pneumatically. The intermediate member may convey forces to clamping members by which a workpiece may

Fig. 14 shows the actuator 10 in use with an auger 132 to which the actuator 10 applies vibratory or impact forces to improve the effectiveness of the auger. An arrangement (now shown) may be provided to allow the auger 132 to be turned while being driven by the actuator 10.

It will be apparent that many variations and modifications can be made to the apparatus as described above without departing from the scope of the present invention. In particular, many features can be used interchangeably in combinations other than those described, which is a particular benefit of the invention. The block member could be assembled from more than one part. Many other piston operation sequences could be devised by appropriate modification of valve arrangements, so that operation of a machine can be modified at will by the simple expedient of appropriate modification to the valve assembly, thus retaining the machine flexible in its application.

CLAIMS

1. Actuator apparatus (10) comprising piston means (18) operable to create driving forces from a supply of pressurised fluid, and valve means (56) operable to supply pressurised fluid to the piston means according to a predetermined sequence, to cause the apparatus to execute a first operation, the valve means and the piston means being housed within a common member (12), and the apparatus being characterised in that the valve means or the piston means or both being removable from the member for replacement by an alternative means operable within the common member to cause the apparatus to execute an alternative operation, and wherein the or each valve means comprise a valve arrangement rotatable within a housing (20), there being ports (64,66,72,82,88, 89,100,104,107) in the housing walls for pressurised fluid, and the valve arrangement carrying partitions (84) which serve to change the connections between the fluid ports in accordance with the predetermined sequence as the valve arrangement rotates, and wherein the valve arrangement of the or at least one of the valve means is axially movable to change the predetermined sequence.

2. Apparatus (10) according to claim 1, characterised in that the valve means (56) is removable for replacement with an alternative valve means operable to supply fluid according to an alternative sequence.

3. Apparatus (10) according to claim 1, characterised in that the valve arrangement (56) has a first axial position at which a wider fluid path is provided to one face of the piston means (18) than to the other, and is movable to a second axial position at which a narrower fluid path is provided to the said one face than to the other.

4. Apparatus (10) according to claim 1, 2 or 3, characterised in that the valve means (56) has a port (96A) having a width which is not constant in the axial direction of the valve arrangement, whereby the effective width of the fluid path to the piston means (18) can be set by setting the axial position of the

valve arrangement.

5. Apparatus (10) according to any preceding claim, characterised in that the valve arrangement (56) provides drive alternatively to opposite faces of a piston (18) of the piston means, whereby to create reciprocation.

6. Apparatus (10) according to any preceding claim, characterised in that the valve arrangement (56) is formed to complete a plurality of cycles of the piston means (18) for each full turn of the valve arrangement.

7. Apparatus (10) according to claim 6, characterised in that the valve arrangement (56) has a first axial position in which a first number of cycles are completed for each full turn of the valve arrangement and a second axial position in which a different number of cycles is completed for each full term.

8. Apparatus (10) according to claim 7, characterised in that the fluid path to the piston means (18) is relatively narrow in the first axial position, and relatively wide in the second axial position.

9. Apparatus (10) according to any preceding claim, characterised by further comprising intermediate means (30) to which driving forces are provided by the piston means (18), and which convey driving forces to an item (38) being driven.

10. Apparatus (10) according to claim 9, characterised in that the item (38) is an item of tooling or a pile element.

11. Apparatus (10) according to claim 9 or 10, characterised in that the intermediate member (30) provides for movement to align the tooling.

12. Apparatus (10) according to claim 11, characterised in that the alignment movement is provided hydraulically or pneumatically.

13. Apparatus (10) according to any of claims 9 to 12, characterised in that the intermediate member (30) conveys forces to clamping members (16) by which a workpiece (38) is clamped, in use.

14. Apparatus (10) according to any of claims 9 to 13, characterised in that the clamping members (16) extend at an angle to the intermediate means (30) to allow side or end clamping of a workpiece (38).

15. Apparatus (10) according to any of claims 9 to 14, characterised in that the intermediate means (30) is elongate.

16. Apparatus (10) according to claim 15, characterised in that the intermediate means (30) extends to one side of the common member (12).

17. Apparatus (10) according to claim 14, 15 or 16, characterised in that the clamping members (16) extend substantially perpendicular to the intermediate means (30).

18. Apparatus (10) according to any of claims 9 to 17, characterised in that the intermediate means (30) extend through a passage (107) within the piston means, and have enlarged heads against which the piston means (18) may act in either of two opposite directions.

19. Apparatus (10) according to any preceding claim, characterised by comprising resilient members (57) against which the piston means (18) acts, in use.

20. Apparatus (10) according to claim 19, characterised in that the piston means (18) are isolated by the resilient members (57) from direct impacts, whereby to create vibratory driving forces.

21. Apparatus (10) according to claims 19 or 20, characterised in that the piston means (18) create impact forces when the resilient members (57) are fully

compressed.

22. Apparatus (10) according to any preceding claim, characterised in that the apparatus is adapted for resilient attachment to a mounting arrangement (15) by means of which the apparatus may be supported by a conventional support arrangement (22).

23. Apparatus (10) according to claim 22, characterised in that the support arrangement (22) is provided by a conventional excavator or like machine.

24. Apparatus (10) according to claim 23, characterised in that the support machine is operable to apply crowd forces to the apparatus.

25. Apparatus (10) according to claim 23 or 24, characterised in that the support machine is able to supply pressurised fluid to the apparatus.

26. Actuator apparatus substantially as described above, with reference to the accompanying drawings.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
MPS/7002INT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 99/ 03785	12/11/1999	14/11/1998
Applicant		
ALDRIDGE PILING EQUIPMENT (HIRE) COMPANY...et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 3

[X] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/03785

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E02D11/00 E02D7/20 F15B15/20 F15B15/18 F15B21/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E02D F15B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 4 371 042 A (KUEHN HANS) 1 February 1983 (1983-02-01) column 3, line 56 -column 10, line 36; figures 1-3	1,12-14, 19 3,5,8,17 2,4
Y A	EP 0 388 498 A (MENCK GMBH) 26 September 1990 (1990-09-26) column 3, line 29 -column 8, line 7; figures 1-4	3,5,8 1,2, 12-19
Y A	WO 97 04926 A (RAUNISTO AIRI ;RAUNISTO YRJOE (FI)) 13 February 1997 (1997-02-13) page 3, paragraph 3	17 13-16, 19,20

-/—

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 February 2000	22/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Tellefsen, J

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Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19 57 469 A (SIEKE H) 27 May 1971 (1971-05-27) page 3, line 32 -page 4, line 8; figures 1-11	5-8,11
A	EP 0 675 233 A (AKTSIONERNOE OBSCHESTVO ZAKRYT) 4 October 1995 (1995-10-04) column 5, line 30 -column 10, line 43; figures 1-5	13-15, 19,20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 99/03785

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